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BEHAVIOUR OF SEA FREIGHT TRAFFIC MODEL

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Abstract

The difficulty in determining the exogenous variables of sea traffic, both global and national, arising mainly from its complex relation with the economy, makes it necessary to turn to a theoretical analysis tool which is not always available in the required spatial area. The present paper models the behaviour of Spanish sea freight traffic in order to verify the variables which define it. To do this, we first formalise a theory on the demand for sea transport of a country, which provides useful references for the process of selection of exogenous variables. In the configuration of Spanish sea traffic the decisive factors are the GDP, the Exchange Rate, inflation and industrial production.

Keywords: Maritime traffic , Maritime economic, Sea traffic demand.

INTRODUCTION

The temporary coincidence of the world economy cycles and the sea transport market points to a clear relation between global economic activity, international trade and sea transport (Isserlis, 1938). This relation seems to be beyond all doubt since the global economy generates most of the sea traffic through the trading of raw and manufactured materials (Stoptfor, 1997). Moreover, the growth rates of the

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world's sea traffic and the industrial production of the countries of the OCDE follows a similar pattern. However, several aspects of the global economy bring about substantial changes in the dimensions of sea traffic, converting this obvious relation into a complex one.

In 'maritime' countries, the volume of freight transported by sea and the national economy are also related; but the factors which determine the complexity of this link do not coincide completely with those which intervene on an international level.

Thus, the evolution of sea transport traffic does not always follow the same pattern in the national and international areas. Some of the variables which determine the international magnitude of sea transport traffic clearly have an influence on the levels of traffic in certain countries, but other factors on a national level must be taken into account.

However, the total demand for sea transport of a country does not correspond to its total sea traffic. The volume of sea traffic is determined by the tonnes of freight transported by sea in the import, export and national coastal trading. In contrast, the demand is given by the product of the tonnes transported (sea traffic) and the distance covered (Tm x miles).

At the same time, the variables which condition demand can be applied to those which define traffic, as long as they refer to the same spatial area. Thus, the theory of national sea transport demand can help to establish the relevant variables for national see traffic.

The works which analyse the demand for sea traffic generally approach the task in the context of the economic theory of sea transport. Most tend to establish relations between the economy and sea transport. Some of the most important works are those of Tinbergen (1959), Maizels (1963), Kindleberger (1967), Metaxas (1971), Goss (1982), Chrzanowski (1985), Stopford (1988), Evangelista and Morvillo (2000), Ishiguro and Inamura (2001), Tvedt (2003), Yap and Lam (2004), Kavussanos et al. (2004), Button (2005), Laulajainen (2006), Glen (2006), Scarsi (2007) and Thoma and Wilson (2007).

In the literature on sea transport, some of the most important are those which deal with the phenomenon of prediction and among the more recent of these are the works of Li and Parsons (1997), Cullinane et al (1999), Babcock et al., (1999), Kavussanos and Nomicos (2000), Veenstra and Haralambides (2001), Babcock and Lu (2002), Mostafa (2004) and Batchelor et al. (2007).

The aims of the present work are twofold: firstly, to formalise a theory on the demand for national sea traffic as an element of general reference; secondly, to model empirically Spanish sea traffic, defining the exogenous variables determining it.

The availability of a behaviour model for Spanish sea traffic enabling predictions to be made about this traffic in the future is of great benefit both for the public and the private sectors. The Spanish Port Authorities, knowing the magnitude of this traffic and its evolution, will have at their disposal a tool to help them in their planning for

future port services and infrastructure needs. The private sector will be able to organise their activity better since the information on the predicted volume of traffic will allow them to estimate the foreseeable volume of trade. Transport companies will be able to improve the design of their marketing strategies. Stevedore companies will be able to establish the needs for loading and unloading equipment. In short, all of the operators involved will be able to adjust their offer to the real needs for their services.

THE DEMAND FOR SEA FREIGHT TRANSPORT OF A COUNTRY

Although there is, in the maritime sector, a wide range of loads which operate in the different markets (special, general and bulk), this work will consider only the overall demand for sea freight transport (Pinacho, 1978). On a national level, this is made up of those national and/or foreign sea transport services which the various operators wish to use for transporting goods, as imports, exports or coastal trading, at a specified price. Since one very important factor in sea transport is the distance covered, sea freight transport is often expressed in Tm x Mile (product of tonnes transported and miles covered).

At first sight, it might be stated that the demand for sea transport of a country will be determined mainly by the price of the service (chartering), that of the secondary services (alternative means of transport), that of complementary goods and services (transported goods and port infrastructure services), by income levels (production and consumption) and by the average distance which the freight needs to cover. Each of these factors will be analysed separately, except for production, consumption and transported goods, which will be considered in a section on the national economy.

Chartering Costs

The influence of chartering costs on the demand for national sea transport, as is the case in the worldwide context, is minimal, and thus the demand curve will behave very rigidly with respect to the service price factor. Charters usually add up to only a small amount of the final price of the goods in the port of destination. High charters (rates) are sometimes established in the context of regular lines and protected and/or guarded traffic. However, the lack of relevance of this variable in relation to the demand for sea transport is widely recognised by all authors. In any case, the response to the demand for transport of a country to the variations in charters is negative.

Alternative Services

Global sea transport is, to a large extent, irreplaceable and the various degrees of 'substitution' can normally be pinned down to the various maritime subsectors. This situation, however, is not true of the national arena. In the internal transport of freight, t rail and road transport constitute replacements for sea transport. The degree of

replacement, in import and export traffic, depends both on the position and distance to the countries with which we are trading and on the characteristics of the load. A rise/fall in the prices of alternative services (rail and road) leads to an increase/fall in the demand for sea transport. The relation between these two variables is positive.

National Economy

The demand for sea transport services is derived mainly from the demand for goods destined for production and consumption. This relation between sea transport and the national economy is obvious for any 'maritime' country, since a large part of its trading in raw materials and manufactured products will be done by sea. This is not, however, a simple relation, since certain highly diverse factors, both internal and external, which affect the national economy can also affect the demand for sea transport. We shall study three factors related with national trading levels: national production and that of the countries with which commercial relations exist, exchange rate and inflation. When analysing each of these, it will be assumed that the rest of the factors which affect the demand for sea transport remain constant.

National Production and production of countries traded with

National production makes a significant contribution to the generation of transport, both external and internal. Part of this will be channelled through sea transport in the form of importing, exporting or coastal trading, affecting the demand for national sea transport. The demand for raw materials and intermediate goods destined for production requires external flows (imports) and internal flows (coastal trading) of goods. The output needs to be transported to the distribution and consumption centres abroad (exports) and inside the country (coastal trading).

The production of those countries with which commercial relations are maintained will contribute to the generation of external transport. The part made by sea will be in the form of importing and exporting. If we are suppliers/customers of these countries, we will contribute to/require of their production exporting/ importing goods to/from them.

In keeping with the above, the increases/reductions both in national production and in that of the countries traded with will lead to rises/falls in the demand for national sea transport (always under the condition established above, that the distance does not vary). The relation between these two variables is, in both cases, of the same direction (positive or negative).

Exchange Rate

Variations in the exchange rate affect a country's foreign trade and, as a consequence, the demand for national sea transport. Exchange rate increases will promote exports and discourage imports, while reductions will produce the opposite effects.

The final ratio between imports and exports and, thus, the nature, whether positive or negative, of the repercussions on the demand for national sea transport will depend on the elasticity of the national/foreign demand for import/export products.

Several different situations may arise. In the case of a rise in the exchange rate, the fall in imports (∇I) may be greater, equal to or less than the increase in exports (ΔE) so that foreign trade will be reduced, will remain invariable or will increase, respectively. But, what percentage of these trade flows are channelled by sea, affecting the demand for sea transport? In each of the above cases, it may occur that the percentage of import trade channelled by sea (%Im) will be greater, equal to or less than the same concept in the export trade (%Em).

Bearing in mind these possibilities, we have elaborated the Table 1 to show the nature (positive or negative) of variations in demand for national sea transport in response to an exchange rate increase.

Table 1. Responses of demand for sea transport to an increase (Δ) in the exchange rate

VARIATIONS IN FOREIGN TRADE		FOREIGN TRADE CHANNELLED BY SEA		
		1	2	3
		$\%Im^c > \%Em^d$	$\%Im^c = \%Em^d$	$\%Im^c < \%Em^d$
A	$\nabla I^a > \Delta E^b$	a_1 (<0)	a_2 (<0)	a_3 (?)
B	$\nabla I^a = \Delta E^b$	b_1 (<0)	b_2 (=0)	b_3 (>0)
C	$\nabla I^a < \Delta E^b$	c_1 (?)	c_2 (>0)	c_3 (>0)

Developed by authors

^{a} = fall in imports
^{b} = increase in exports
^{c} = percentage of import trade channelled by sea
^{d} = percentage of export trade channelled by sea

A) Reduction in foreign trade of a country (∇I > ΔE)

a_1) If the percentage of trade transported by sea is greater in imports than in exports, the demand for sea transport will be reduced. Thus, it is to be expected that the variations in the demand for sea transport in response to a modification in the exchange rate should be negative.

a_2) If the percentage transported by sea is the same for both traffics, a reduction in the demand for sea transport will be expected, but in this case, the variation will be somewhat less in absolute values. The response will be negative (reasoning as in a_1).

a_3) In this case, we do not know what will happen with the demand for sea transport, as this will depend on the total trade figures. In some cases, it will

grow and in others it will fall and thus in general the nature of the influence in this case is unknown.

B) Foreign trade does not vary ($\nabla I = \Delta E$)

b_1) In the case where the percentage of participation of sea transport is greater in the import trade than in the export trade, there will be a reduction in the demand for sea transport. Thus, the demand will respond negatively to an increase in the exchange rate.

b_2) If the percentages of participation of sea transport in both trades is the same, the variations in traffic in a positive or negative direction will be compensated by variations in the opposite direction in the other traffic. Neither the trade nor the demand for sea transport will vary. As the exchange rate has no influence, the relation will be neutral, neither positive nor negative.

b_3) If the percentage of imports transported by sea is lower than that of exports, there will be an increase in the demand for sea transport, and thus the influence will be positive (this case is the opposite of al b_1).

C) Growth of a country's foreign trade ($\nabla I < \Delta E$)

c_1) When the percentage of imports channelled by sea is greater than that of the exports, we do not know what the effects will be on the demand for sea transport. This will depend on the total trading figures.

c_2) If the percentages transported by sea are the same, there will be an increase both in trade and in the demand for sea transport. The relation between the two variables is positive.

c_3) If the percentage of trade undertaken by sea is greater for imports than for exports, there will be an increase in the national sea traffic, so that it will respond to demand in a positive way (it is different from c_2 in that the variations will be more profound in absolute terms).

As well as the above, an increase in the exchange rate will favour the substitution of import products with internal products, which will promote coastal trading.

Inflation

When analysing the effects of inflation on the demand for the sea transport of a country, two possible origins are contemplated which give rise to what is known as demand inflation and cost inflation. Demand inflation will lead to an increase in internal production and imports. In both cases, an increase in the national internal and foreign sea trade can be expected, and thus, so can a rise in demand for sea transport. Cost inflation will lead to a reduction in exports, through loss in competitiveness of our products, with the consequent deterioration in the national production and an increase in imports. Moreover, there will also be repercussions in consump-

tion, probably with a substitution of the demand for national goods with a demand for foreign goods, which will make imports increase.

In keeping with the above, the rise in the internal prices of a country will boost its imports (ΔI) and reduce exports (∇E). The different situations which may arise and the nature of the relation between inflation and demand for sea transport are formalised in the Table 2, using similar reasonings as those used for the case of exchange rates.

Table 2. Responses of demand for national sea transport to inflation

VARIATIONS IN FOREIGN TRADE	FOREIGN TRADE CHANNELLED BY SEA		
	$\%Im^c > \%Em^d$	$\%Im^c = \%Em^d$	$\%Im^c < \%Em^d$
$\Delta I^a > \nabla E^b$ Foreign trade grows	(>0)	(>)	(?)
$\Delta I^a = \nabla E^b$ Foreign trade does not vary	(>0)	(=0)	(<0)
$\Delta I^a < \nabla E^b$ Foreign trade drops	(?)	(<0)	(<0)

Developed by authors

^{a} = increase in imports
^{b} = fall in exports
^{c} = percentage of import trade channelled by sea
^{d} = percentage of export trade channelled by sea

Port Services and Infrastructures

The services and infrastructures of commercial sea ports can be considered as complementary economic goods of sea transport.

Port services make up a part of the cost of sea transport and that of the goods in the port of destination. The cost of all port operations is usually distributed between shipowners and stevedores/receivers. Thus, the services lent to the ship affect the cost of transport. Those services corresponding to the handling of the goods can be charged to the shipowners and/or the owners of the freight. This choice depends on the type of market in which the operation takes place (regular line or tramp) and, finally, on the conditions of chartering. In any case, irrespective of the question of who pays for the port services, a reduction in tariffs will have positive effects on the demand for sea traffic, provided that this reduction is reflected in the price of the services and the port traffic is not guarded traffic. Bearing in mind these aspects and assuming the opposite effects to those indicated for the case of an increase in tariffs, the relation between demand for sea transport and the price of port services is negative.

Investments in port infrastructures (e.g. the creation of specialised terminals), if these are carried out in response to a potential demand, can help to capture and/or

generate new traffic. The question here is not one of diverting traffic from other national ports, as this would be of no relevance to the total sea traffic of a given country, but rather of diverting traffic from other alternative means of transport and even from the ports of other countries. Thus, such investments will have a positive effect on the demand for sea transport on a national level, a positive relation being established between these two factors. Due to the time that elapses between the beginning of the works to the actual opening of services of the infrastructures, there may well be a time gap. Thus, the port investments of today will have a positive influence on the future demand for sea transport.

Mean Distance

Demand is also a function of the distance (measured in miles) over which the freight is transported. The same load, transported over a greater distance, generates more demand for transport than the same tonnage transported to closer destinations. The distance may vary due to the opening or closing of canals, changes in the locations of suppliers or consumers, trade agreements, and so on. In response to an increase/reduction in distance, an expansion/contraction of the demand for sea transport can be expected, so that the relation between these two factors is positive.

THEORETICAL MODEL OF DEMAND FOR SEA TRANSPORT OF A COUNTRY

In keeping with the above section 2 (The demand for sea freight transport of a country), we have formalised a theoretical model which establishes the variables which determine the sea transport of a country, as follow

$$D_t = f\,(F_t, AS_t, PIn_t, PEx_t, TC_t, IPC_t, TP_t, IP_{t-d}, M_t) \quad (1)$$

Where:

D	Demand for sea transport of a country
F	Prices of services of sea transport (charters)
AS	Prices of alternative services (rail and road)
PIn	Production of country
PEx	Production of countries with which commercial relations exist
TC	Exchange rate
IPC	Inflation
TP	Tariffs of port services
IP	Investment in ports
M	Distance covered in transporting freight(miles)
t	Time
d	Delay or Time Gap

The variations in demand for national sea transport will be positive or negative in response to variations in above concepts:

$$\frac{\partial D_t}{\partial F_t} \leq 0 \qquad \frac{\partial D_t}{\partial AS_t} \geq 0 \qquad \frac{\partial D_t}{\partial PIn_t} \geq 0$$

$$\frac{\partial D_t}{\partial PEx_t} \geq 0 \qquad \frac{\partial D_t}{\partial TC_t} \gtrless 0 \qquad \frac{\partial D_t}{\partial IPC_t} \gtrless 0$$

$$\frac{\partial D_t}{\partial TP_t} \leq 0 \qquad \frac{\partial D_t}{\partial IP_{t-d}} \geq 0 \qquad \frac{\partial D_t}{\partial M_t} \geq 0$$

VARIABLES CONDITIONING SPANISH SEA TRAFFIC

In the search and selection of the variables which define Spanish sea traffic, both the theory of demand for sea traffic of a country outlined in the section above and the works[1] of Marlow and Gardner (1980) and Blanco (1994) have been taken into account.

Table 3. Selection of variables which determine Spanish sea traffic

SECTORIAL	SPATIAL	
	World	**National**
GENERAL	❑ Global exports ❑ Gross Domestic ❑ Product (GDP) both Industrial and Developing countries ❑ Industrial production of industrialised countries	❑ Imports-Exports ❑ GDP ❑ Industrial Production ❑ Industrial Price Index ❑ Consumer Price Index ❑ Exchange rate
ALTERNATIVE TRANSPORT		❑ Prices ❑ Public Administration Expenses
MARITIME	❑ Charters per voyage (oil and dry load)	❑ Investment in Infrastructures ❑ Public Administration Expenses in sea transport ❑ Maritime service tariffs (Transmediterranean)

Developed by authors

The national economic variables considered were general (production, trade and prices) related with alternative transport by road and rail (prices and expenses) and

[1] Marlow and Gardner build a supply-demand model on a global level for the bulk loading subsector. Formalising demand, they establish as exogenous variables the index of charters per journey, the GDP of the developed countries, (OCDE) and an index which reflects the efficiency of the developed countries in the conversion of raw materials into finished products. Blanco analyses the Spanish sea transport sector and, studying demand, builds an empirical model of the behaviour of Spanish sea traffic.

maritime (investments, expenses and prices). Similarly, some variables of an international nature have been considered, such as 'proxi' variables of the foreign trading relations of Spain, both general (production and exports) and sectorial (charters), as most Spanish foreign trade is channelled through foreign shipping companies which apply international charters. In keeping with the above, Table 3 groups together the exogenous variables which will later be used in the empirical model.

In our selection, we have used only independent variables for which there is statistical data gathered autonomously[II], and have disregarded other data related with the sector, both on a worldwide and a national level, considered to be of questionable reliability. The price of the service, despite what has been indicated above as to its lack of relevance in the configuration of demand, has been included for the purposes of the empirical comparison.

SPANISH SEA TRAFFIC BEHAVIOUR MODEL

The model formalised to establish which variables determine the behaviour of Spanish sea traffic, are designed to verify the following hypothesis:

1ª) National production, as a measurement of the economic activity of a country, is closely related with the level of the total national sea traffic (foreign and coastal traffic).

2ª) The production of the countries with whom commercial relations are maintained affects the dimension of a country's foreign sea trade.

3ª) The national currency exchange rate has an influence on the volume of the Spanish sea traffic of imports and exports.

It should be noted that in the estimates presented[III] some of the variables which had been previously selected proved not to be significant. These variables were the prices of the various means of transport (sea, road and rail) and the expenditure of the Public Administrations on these means.

The Model

The model established for the period 1960-2003, presents the results shown in Table 4 and Fig.1. In the estimates made, the Spanish GDP, at market prices,

[II] Consulted sources of Data: ANAVE Informe anual. Asociación de Navieros Españoles, Yearbooks 1977-1991. Banco de España Informe anual. Apéndice estadístico. Yearbooks 1980-1991. Data Service(2005). DSI Data Service & Information [online], Xantener Str. 51a . D-47495 Rheinberg . Germany . Available from: http://195.145.59.167/ISAPI/LogIn.dll/login?lg=e - [Accesed 1 February 2005]. Instituto Nacional de Estadística: Anuario estadístico. Yearbooks 1960-1991; Contabilidad Nacional de España. Yearbooks 1964-1990. International Monetary Fund International, Financial Statistics: Yearbooks 1986 and 1990- 2000; Data Base in CD-ROM (2005). Ministerio de Fomento Secretaría General Técnica. Madrid: Yearbooks 1970-1975 and 1999-2003. Ministerio de Hacienda Estadística del comercio Exterior de España. Memoria de Tráfico de cabotaje (Origen y destino de mercancías). Yearbooks 1974-1987. Ministerio de Obras Publicas y Urbanismo Memoria General de Puertos: Yearbooks 1967-1989, Yearbooks 1992-93. Ministerio de Transportes, Turismo y Comunicaciones Estadísticas de transportes: Series cronológicas (1950-80), Yearbooks 1973-1977, 1978-1983 and 1984-1998. O.C.D.E. (1972) Maritime Transport 1971-1974 and 1987-1992.

[III] Other econometric models have been estimated for the behaviour of Spanish sea traffic. In all cases, the positive influence of inflation has been pointed out. An increase in inflation will lead to an increase in Spanish sea traffic, through the increase in imports (to the detriment of exports and internal production) is verified with greater intensity in the maritime sector.

behaved in isolation more significantly than industrial production. However, we have chosen the latter as it adapts better to the introduction of exogenous variables in the modelling.

Table 4. Behaviour Model for Spanish Maritime Traffic.

Dependent Variable: TNCABIE2
Method: Least Squares
Sample(adjusted): 1960-2003 Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5 304.039	25 578.04	-0.207367	0.8368
PROIND00	1 314.676	1.997.445	6.581.791	0.0000
TCEFEC00	-8.182.875	8.251.306	-0.991707	0.3276
PIBPIN00	1 608.000	2.584.531	6.221.632	0.0000
F2001	27 592.30	5 809.732	4.749.325	0.0000
MA(1)	0.545830	0.139379	3.916.165	0.0004

R-squared	0.994676	Mean dependent var	165 415.5
Adjusted R-squared	0.993976	S.D. dependent var	76 952.75
S.E. of regression	5 972.726	Akaike info criterion	2.035.392
Sum squared resid	1.36E+09	Schwarz criterion	2.059.722
Log likelihood	-4.417.862	F-statistic	1 419.984
Durbin-Watson stat	1.777.257	Prob(F-statistic)	0.000000
Inverted MA Roots	-.55		

Meaning of variables:

TNCABIE2 = Total Spanish sea traffic. Developed by authors. Tcab + TL. Units in thousands of tonnage.

Tcab = Spanish coastal trading traffic. Thousands of tonnes. Source: MTTC y MOPT.

TL = Spanish import and export sea traffic. Thousands of tonnes. Source: MTTC and MOPT

PIBPIN00 = Index of the GDP of industrialised countries at constant prices. Base year 2000. Source: IMF.

PROIND00 = Index of Spanish industrial production. Base year 2000. Source: IMF.

TCEFEC00 = Index of Nominal Effective exchange rate. Base year 2000. Source: IMF.

F2001 = Dummy variable: =0 for sample 1960-2000. =1 for sample 2001-2003

MA = Moving Average

t = Period

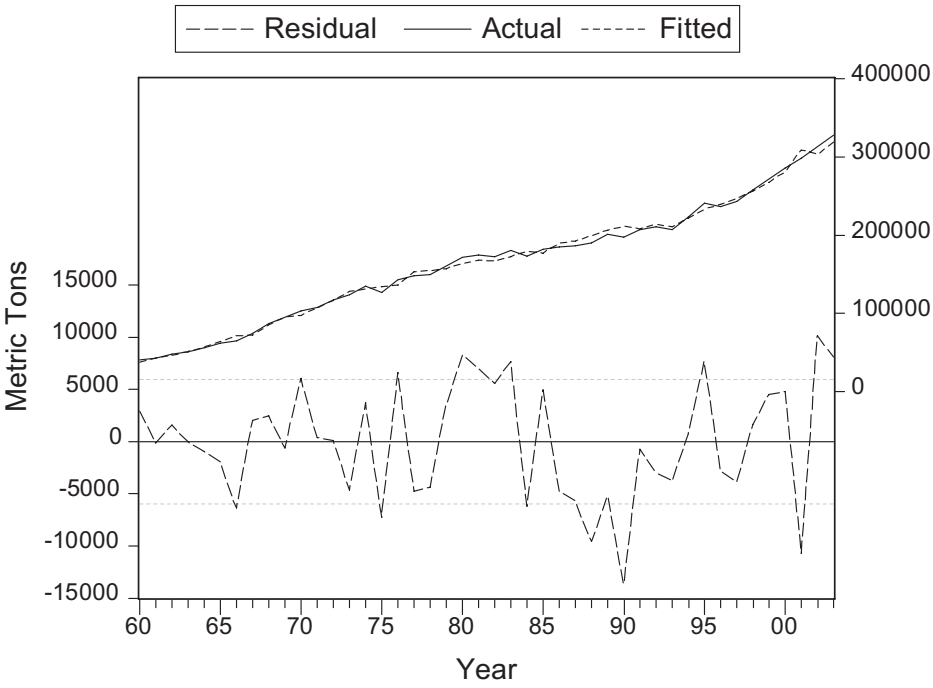

Fig.1. Spanish sea traffic model.

The values obtained from the estimation are generally correct, both with respect to the individual significance of the parameters of each variable and to the overall comparisons. With the exception of a few errors, quite high for some years, the model fits satisfactorily the real evolution of the variable. The Durbin Watson coefficient rules out the autocorrelation at the significance level of 1%.

The influence of Spanish industrial production (proind00) on the sea traffic of the country is positive (hypothesis 1 is accepted). Expansions/contractions in national production will generate an increase/reduction in sea traffic in two directions:

a) Towards the centres of national production (sea traffic in coastal trading and imports).
b) Towards the centres of distribution and consumption of national products (sea traffic in coastal trading and exports).

In recent years, the participation of sea transport in the movement of Spanish freight has decreased, both for internal and for external traffic. In the former case, this is due to the improvement in internal infrastructures and in the latter case, to the closer links with Europe as the origin and destination of our trade. Coastal trading makes up over 10% of the internal movement of freight, while in external freight

traffic, sea transport accounts for 68% of the total, its participation in imports being around 77% and in exports around 47%. Moreover, in Spanish sea traffic, the participation of coastal trading is around 12%, the remaining 88% corresponding to external traffic. Thus, any variation in national production will affect mainly external Spanish sea traffic.

The relation between the production of the countries with which we maintain commercial links (pibpin00) and Spanish sea traffic (tncabie2) is positive. An expansion/contraction in the production of these countries will increase/reduce our foreign trade sea traffic (hypothesis 2 is accepted). In the estimates made, Spanish sea traffic has generally responded more to changes in production that to changes in trade. Thus, the GDP, whether global, of the industrialised countries or developing countries has proven to be more significant than global exports.

The TCEFEC00 variable indicates the response of Spanish foreign trade sea traffic to the relative variations in the prices of goods. Similarly, in the short term, the exchange rate promotes speculative movements. The negative effect of the exchange rate responds to a structural characteristic of the country's sea traffic. In Spain, as outlined above, the percentage transported by sea is greater in the import trade than in the export trade. A rise in the exchange rate, which boosts exports and reduces imports, will result in a reduction in Spanish sea traffic. The effects produced by a fall in the exchange rate will be the opposite of the above (hypothesis 3 is accepted).

F2001 is a dummy variable. It has been enclosed in the model because the currency change from peseta to euro affects the exchange rate.

CONCLUSIONS

The prices of sea transport services and their replacements (road and rail) have not proven to be decisive factors in the evolution of the levels of Spanish sea traffic. This traffic, it seems, will evolve in the same direction as the general trend in the country's economy, leading to expansion/contraction according to this trend.

The sea traffic will depend positively on industrial production, both Spanish and that of the countries with which Spain maintains economic relations. The positive or negative nature of the variations in sea traffic in response to the exchange rate is derived from the structural characteristics of Spanish sea traffic, in that its participation in the imports trade is greater than in that of exports.

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MODELO DE COMPORTAMIENTO DEL TRAFICO MARÍTIMO

Resumen

La dificultad para determinar las variables exógenas del tráfico marítimo, tanto mundial como nacional, principalmente originada por su compleja relación con la economía, plantea la necesidad de recurrir a una herramienta teórica de análisis no siempre disponible en el ámbito espacial requerido. En el presente trabajo, cuyo objetivo es la modelización del comportamiento del tráfico marítimo español de mercancías, se ha creído preciso previamente formalizar una teoría sobre la demanda de transporte marítimo de un país, como referencia necesaria en la selección de las variables.

LA DEMANDA DE TRANSPORTE MARÍTIMO DE MERCANCÍAS DE UN PAÍS

En una primera aproximación, de acuerdo con la teoría económica, se puede afirmar que la demanda de transporte marítimo de un país va a estar determinada principalmente por el precio del servicio (flete), el de los servicios sustitutivos (modos alternativos de transporte), el de los bienes y servicios complementarios (mercancías transportadas y servicios e infraestructuras portuarias), por el nivel de renta (producción y consumo) y por la distancia media que deben recorrer las mercancías. Se analizan dichos factores por separado salvo la producción, el consumo, y las mercancías transportadas, que serán abordados en un apartado denominado economía nacional.

VARIABLES CONDICIONANTES DEL TRÁFICO MARÍTIMO ESPAÑOL

En la búsqueda y selección de las variables explicativas del tráfico marítimo español se han tenido en cuenta la teoría de la demanda del transporte marítimo de un país y los trabajos de Marlow y Gardner (1980) y Blanco (1994). Marlow y Gardner, construyen un modelo de oferta-demanda a nivel mundial del subsector de carga seca a granel. Al formalizar la demanda establecen como variables exógenas el índice de fletes por viaje, el Pib de los países desarrollados (OCDE) y un índice que refleja la eficiencia de los países desarrollados en la conversión de materias primas en productos elaborados. Blanco, analiza globalmente el sector del transporte marítimo español y, en el ámbito de la demanda, construye un modelo empírico de comportamiento del tráfico marítimo español.

Se han seleccionado variables económicas nacionales de carácter general (producción, comercio y precios), relacionadas con los transportes alternativos por car-

retera y ferrocarril (precios y gastos) y marítimas (inversiones, gastos y precios). Asimismo se han tenido en cuenta algunas de ámbito internacional, como variables "proxi" de nuestras relaciones comerciales con el exterior, tanto generales (producción y exportaciones) como sectoriales (fletes), ya que la mayoría del comercio exterior español es canalizado a través de navieras extranjeras que aplican fletes internacionales.

MODELO DE COMPORTAMIENTO DEL TRÁFICO MARÍTIMO ESPAÑOL: HIPÓTESIS Y RESULTADOS

El modelo formalizado para establecer qué variables determinan el comportamiento del tráfico marítimo español, pretenden contrastar las siguientes hipótesis:

1ª) a producción nacional, como medida de la actividad económica del país, está estrechamente relacionada con el nivel de tráfico marítimo nacional total (exterior y cabotaje).
2ª) La producción de los países con los que mantenemos relaciones comerciales afecta a la dimensión del comercio exterior marítimo nacional.
3ª) El tipo de cambio de la peseta influye en el volumen de tráfico marítimo español de importación y exportación.

En las estimaciones realizadas no se han mostrado significativas algunas variables que habían sido previamente seleccionadas. Se trata de los precios de los distintos modos de transporte (marítimo, carretera, y ferrocarril) y de los gastos de las Administraciones públicas en los mismos.

La influencia de la producción industrial española en el tráfico marítimo del país es de signo positivo (se acepta la hipótesis 1). Expansiones/contracciones de la producción nacional generarían un incremento/reducción del tráfico marítimo en dos sentidos:

a) Hacia los centros de producción nacionales (tráficos marítimos de cabotaje e importación).
b) Hacia los centros de distribución y consumo de productos nacionales (tráficos marítimos de cabotaje y exportación).

La relación entre la producción de los países con los que mantenemos vínculos comerciales y el tráfico marítimo español es positiva. Una expansión/contracción de la producción de dichos países incrementará/reducirá nuestro tráfico exterior marítimo (se acepta la hipótesis 2). En las estimaciones realizadas, el tráfico marítimo español ha respondido, en general, más a movimientos de la producción que del comercio. Así se ha mostrado más significativo el PIB ya sea mundial, de los países industriales o en vías de desarrollo, que las exportaciones mundiales.

La variable Tipo de Cambio muestra la respuesta del tráfico marítimo exterior español a las variaciones relativas de los precios de las mercancías. Asimismo a corto plazo el tipo de cambio favorece movimientos especulativos. El signo negativo del tipo de cambio obedece a una característica estructural del tráfico marítimo del país. En España, el porcentaje que se transporta por mar es mayor en el comercio de importación que en el de exportación. Una subida del tipo de cambio, que favorece las exportaciones y reduce las importaciones, tendría como resultado un deterioro del tráfico marítimo español. Los efectos originados por una bajada del tipo de cambio serían contrarios a los indicados (se acepta la hipótesis 3).

CONCLUSIONES

Los precios de los servicios de transporte marítimo y de sus sustitutivos (carretera y ferrocarril) no han resultado ser factores determinantes en la evolución de los niveles de tráfico marítimo español. Al parecer dicho tráfico va a evolucionar en el mismo sentido que la dinámica general de la economía del país, produciéndose expansiones o contracciones según sea el signo de dicha evolución.

El tráfico marítimo dependerá positivamente del índice de la producción industrial, tanto española como de los países con los que mantenemos relaciones comerciales, y negativamente de la evolución de los tipos de cambio. El signo de las variaciones del tráfico marítimo en respuesta al tipo de cambio se deriva de las características estructurales del tráfico marítimo español. En concreto, por ser mayor su participación en el comercio de importación que en el de exportación.